

STEP III, 2019, Q2 EC

Question 2

The most popular question, it was also the most successful with an average score of over 11/20 and many fully correct solutions. Most candidates that noticed that the equation for $f(x + y)$ implied $f(x) = 0 \forall x$, or $f(0) = 1$ correctly eliminated the former, but quite a few did not realise that it was a possibility to consider. Nearly every candidate successfully found

$f'(x) = f(x) \lim_{h \rightarrow 0} \left(\frac{f(h)-1}{h} \right)$ and most also proceeded correctly from there to find the required differential equation. Finding $f(x)$ was generally successful although some did not check the boundary conditions. In part (ii), there were fewer issues demonstrating that $g(0) = 0$ than there had been with $f(0) = 1$ in part (i). The simplification in order to find the limit to obtain $g'(x)$ was usually successful. Solution of that differential equation was often well done, either using partial fractions or as a hyperbolic function, although some mistakenly identified the solution as a tan function.



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